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Government Intervention and Bank Market Power: Lessons from the Global Financial Crisis for the COVID-19 Crisis

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Abstract

The COVID-19 pandemic could result in large government interventions in the banking industry. To shed light on the possible consequences on market power, we rely on the experience of the global financial crisis and exploit granular data on government interventions in more than 800 banks across 27 countries between 2007 and 2017. For identification, we use a multivariate matching method. We find that intervened banks experience a significant decline in market power with respect to matched non-intervened banks. This effect is more pronounced for larger and longer interventions and is driven by a rise in costs—mostly because of higher loan impairment charges—which is not followed by a similar increase in prices.

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I. INTRODUCTION

The dire economic consequences of the COVID-19 pandemic are unlikely to spare the banking industry. While banks are better capitalized than before the Global Financial Crisis (GFC)—in large part thanks to the reform efforts that followed—they are still likely to experience significant capital shortfalls. In fact, following a wave of business failures, non-performing loans are expected to increase sharply (Gourinchas et al. 2020) and a sizeable tail of banks is expected to be pushed below the minimum capital requirements (International Monetary Fund 2020). Hence, despite post-GFC efforts to improve banks' resolvability, to make bailing in of private stakeholders a viable option, and to limit too-big-to-fail, government interventions in banks might still be inevitable. Some governments might resort to interventions in order to prevent system-wide distress and to contain the economic and social fallout of a financial crisis (Dell'Ariccia et al. 2018).

In light of this scenario, it is crucial to understand whether and how government interventions might impact the functioning of the banking industry. In particular, a first-order problem is the potential impact on market power, as changes in the banks' cost structure and pricing practices have implications for real economic activity, by affecting the cost and availability of credit (Carbò-Valverde et al. 2009; Deli et al. 2019) and the responsiveness of investment to monetary policy (Drechsler et al. 2017; Wang et al. 2020).

In this paper, we explore the implications of government interventions on banks' market power by studying the experience of the GFC, when many governments provided direct injections of equity and/or debt, guarantees and impaired asset relief to support weak financial institutions with the aim to prevent further financial and economic deterioration. Our analysis relies on granular data on government interventions in banks (Igan et al. 2019) across 37 countries for the period 2007–2017, which we combine with bank-level balance sheet and income statement data to examine the behavior of banks' market power, along with its associated components, around the interventions.

We measure market power, which is the ability of firms to price above marginal costs, using the Lerner index. This index is computed as the difference between the average price received on bank assets and the marginal costs of expanding such assets, expressed as a share of the price. In a static equilibrium, such quantity is equal to the inverse of the elasticity of residual demand faced by a firm. This measure is the most commonly used in studies of market power in the banking sector (e.g., Carbò-Valverde et al. 2009; Beck, De Jonghe, and Schepens 2013; Calderon and Schaeck 2016; Delis, Kokas, and Ongena 2016), and, contrary to measures of market concentration, it does not necessitate any assumption on the definition of local markets (Nickel 1996; Aghion et al. 2005; Berger et al. 2009).[1] In addition, the Lerner index, by looking at the mark-up of prices above

[1] This is not to say that that relying on the Lerner index does not also entail some drawbacks. For instance, banks' ability to exert market power could be different across different geographical areas according to the degree of

marginal costs, captures the main channel through which government intervention can affect bank competition (Gropp, Hakenes, and Schnabel 2011).

There are several ways in which interventions could affect banks' prices and costs, thus impacting market power. On the one hand, government interventions could increase banks' market power by reducing their marginal cost of funding. This could happen either if the cost of raising capital or borrowing from the government is lower than doing so from markets, or if government support translates into lower cost of external financing because intervened banks are perceived to be safer. A perception that intervened banks are safer or better in other ways could also allow them to be able to charge higher prices (rates) on loans, also resulting in higher market power. Market power for intervened banks could also be higher if intervention leads to a perceived increased probability of future bailouts that goes hand in hand with lower market discipline, more risk-taking, and higher loan rates. On the other hand, if intervened banks use government support to compete more aggressively by cutting prices, market power would decrease. Intervened banks may also be subject to moral suasion by the government to extend loans and services to a broader clientele at lower prices. Similarly, but from the cost side, if as a result of government support intervened banks are able or are encouraged (due to more stringent oversight) to recognize realized or potential loan losses, banks' costs could increase and market power could drop post-intervention. Hence, the net effect of government interventions on market power is an empirical question.

A simple comparison between the dynamics of banks that received or not received equity or debt injections from the government would be misleading, as these interventions were non-randomly targeted to troubled financial institutions. Hence, to better identify the effects of government interventions on intervened banks' market power, our analysis relies on a multivariate matching procedure on a parsimonious set of covariates (Diamond and Sekhon 2013). Once we match banks on these covariates, the level and evolution of non-targeted observables in the pre-intervention period is very similar between the treated and control groups, allowing for a difference-in-difference empirical design. In this setting, we can compare the differential evolution of the Lerner index between treated and non-treated banks after government intervention.

We find that market power for intervened banks decreases following government interventions and that this effect is more pronounced for larger and longer interventions. The drop in market power seems to be driven by a rise in costs and is not associated with any increase in prices for interest or non-interest products. The increase in costs is mainly the result of higher loan impairment charges. At the same time, we do not observe a rise in risky lending. Our findings are robust to a number of checks and are not driven by specific countries. Combined, our results

competition faced and on local economic conditions. However, we do not have detailed data on pricing of loans (or other products) in different locations. Similarly, balance-sheet data does not allow us to estimate the cost associated to a specific line of business.

suggest that loan impairment charges might have risen either because capital injections allowed banks to recognize losses that they hadn't before or because of the more stringent oversight exercised by the government in the post-intervention period.

While there are many studies on the drivers of interventions (Bayazitova and Shivdasani 2012; Duchin and Sosyura 2012) and the impact of interventions on lending, risk-taking, and economic activity (Black and Hazelwood 2013; Li 2013; Calomiris and Khan 2015; Berger and Roman 2017; Berger et al. 2019; Acharya et al. 2020; Bassett et al. 2020; Berger et al. 2020; Brandao-Marques, Correa, and Sapriza 2020; Duchin and Sosyura 2020), the empirical literature on the effects on banks' market power is relatively scant and primarily focused on the United States.[2] The closest papers to ours are Berger and Roman (2015) and Calderon and Schaeck (2016), who document opposite effects of government intervention on market power.

Analyzing the experience of banks that benefited from the Troubled Assets Relief Program (TARP), Berger and Roman (2015) find, in a bank-level difference-in-difference setup, that TARP-recipient banks increased market shares and market power (measured by the Lerner index). These results are mostly due to the fact that TARP-recipient banks were perceived to be safer than non-TARP-recipient ones, because of additional capital and/or a positive signaling effect. In contrast, looking at a large sample of countries, Calderon and Schaeck (2016) show that government interventions are associated with a decline in the Lerner index (and in net interest margins), suggesting that claims that interventions can reduce banking competition are overstated. We contribute to this literature by conducting a *bank-level analysis* of how interventions affect *market power and its components* across a *large sample of countries* and exploring *different types of interventions* which also vary in size, and duration.[3]

The remainder of the paper is organized as follows. Section II describes the data used and offers some descriptive statistics on government interventions in banks. Section III discusses the empirical methodology, while Section IV presents the main findings and a set of robustness exercises and extensions. Section V concludes.

[2] The theoretical literature has looked at the potential distortive effects of government intervention on bank competition, as bailouts could result in lower margins for non-intervened competitor banks (Hakenes and Schnabel 2010; Gropp, Hakenes, and Schnabel 2011).

[3] A caveat to keep in mind in interpreting our results is that the analysis focuses on the changes in market power *for intervened banks*, while it is silent on the indirect effects of government intervention on unsupported banks. For studies on the indirect effects of bailouts on bank competition, see Hakenes and Schnabel (2010), Gropp, Hakenes, and Schnabel (2011), and Koetter and Noth (2016).

II. DATA

To examine the impact of government interventions on bank market power, we use cross-country data on bank interventions collected by Igan et al. (2019) for the period 2007–2017. This novel, hand-collected dataset differs from other bank-level datasets constructed and used in the recent literature across three main dimensions. First, it covers a broader set of countries (37 to be exact) spanning both advanced economies and emerging markets compared to, for instance, Acharya et al. (2020), which collects data for eurozone countries, and Bassett et al. (2020), which builds a comprehensive dataset of government support to banks, but only for the United States. Second, it also covers a longer time period, relative to others focusing on the few years around the GFC and the eurozone crisis (e.g., Acharya et al. 2020 covers 2007–2012 while Bassett et al. 2020 covers 2007–2010). Third, the coverage in Igan et al. (2019) focuses more narrowly on government support in the form of equity, debt, hybrid securities (e.g., contingent convertible bonds) in addition to guarantees and impaired asset relief. While this leaves out other forms of government support, most notably, direct liquidity support through discount windows and other dedicated facilities, Igan et al. (2019) then track government stakes over time, hence providing information on whether and after what period of time these stakes were divested.[4]

We combine these data with balance sheet and income statement information for banks from Fitch Connect, which we use to construct the Lerner index—our measure of market power—and to capture other bank characteristics used as controls in the analysis. We match banks in the two datasets by name and we are able to trace 76.4 percent of intervened banks in the Fitch Connect dataset. The matched banks are not particularly different from the non-matched ones in terms of asset, profitability and capitalization (Appendix Figure 1), neither are they concentrated in any given country. Also, if we consider the type and size of the intervention, the non-matched cases tend to involve smaller interventions but the magnitude of the differences across matched and non-matched banks is insignificant (Appendix Figure 2).

Our combined dataset covers 27 countries and 25,998 banks, 813 of which has experienced at least one intervention. In total, we have 1,123 interventions which can be classified into equity injections (773 cases), debt support (43 cases), hybrid securities (88 cases), guarantees (83 cases), and impaired asset relief (272 cases).[5] Cumulative direct interventions amounted to $1 trillion, and guarantees extended amounted to $1.5 trillion (Appendix Table 1).

[4] Bassett et al. (2020) also has information on these patterns as they focus on outstanding amounts, while Acharya et al. (2020) focus on initial interventions.

[5] Impaired assets can be acquired from financial institutions by the government or by a unit acting on its behalf; they are recorded as relief when the transfer value of impaired assets onto governments' balance sheets exceeds their market value.

The median number of interventions across countries was 7 (average 42). The majority of the interventions took place in the United States, Russia, and Spain. In terms of size (measured relative to GDP), the median intervention aggregated at the country level was 5 percent of GDP. The largest interventions occurred in Greece (45 percent of GDP) and the smallest in Lithuania (0.1 percent of GDP). The median length of interventions (defined as the time from the first intervention until the government stake was fully divested) was 3 years, with the longest intervention lasting 11 years and the shortest just 1 year.

Intervened banks in the sample are very different from non-intervened banks on the basis of pre-intervention characteristics (Table 1). Intervened banks tend to be larger (as defined by the log of total assets), less profitable (according to the ratio of returns or net income to assets, ROA), hold more loans as a percentage of bank assets, and have less market power (as measured by the Lerner index). These significant differences across banks indicate that a simple difference-in-difference strategy to examine the behavior of banks' market power for intervened banks post-intervention is not appropriate. We address this problem using a multivariate matching algorithm (Diamond and Sekhon 2013), which we describe in the next section.

III. EMPIRICAL METHODOLOGY

A. Measuring Market Power

The first step in our empirical approach requires computing a measure of banks' market power for each bank in the sample for the period 2007–2017. The measure of market power we use, the Lerner index, is defined as:

$$Lerner = \frac{p-mc}{p} = 1 - \frac{mc}{p} \tag{1}$$

where p is the ratio of total income to quantity $Q_{b,t}$ (assets) and marginal costs (mc) are:[6]

$$mc_{b,t} = \frac{\partial C_{b,t}}{\partial Q_{b,t}} = \varepsilon_{b,t} \frac{C_{b,t}}{Q_{b,t}} \tag{2}$$

with $\varepsilon_{b,t}$ indicating the elasticity of costs $C_{b,t}$ to quantity. This elasticity is estimated from a trans-log cost function:

$$\begin{aligned} logC_{b,t} = \alpha\, logQ_{b,t} + \frac{\delta}{2}\, logQ_{b,t}{}^2 + \sum_{j=1}^{J} \beta_j\, w_{j,b,t}\, logQ_{b,t} + \sum_{j=1}^{J} \sigma_j\, w_j + \\ \sum_{j=1}^{J} \sum_{k=1}^{J} \sigma_{jk}\, w_{j,b,t}\, w_{k,b,t} + \gamma X_{b,t} + \mu_b + \pi_t + \epsilon_{b,t} \end{aligned} \tag{3}$$

[6] Note that while c and q are the logs of costs and quantities, C and Q are the actual values.

where the w_j is a set of bank-specific input prices for funds, labor, fixed capital and risk (in logs); $X_{b,t}$ is a set of bank-level time-varying controls to account for banks' capitalization (equity over assets), business model (loans to assets) and loan quality (non-performing loans, NPLs, over gross loans); and μ_b and π_t are bank and year fixed effects. The vector of input prices includes, as standard in the literature (e.g., Berger et al. 2009; Beck et al. 2013; Love and Martínez Pería 2015): total interest expenses over deposits as price of borrowed funds, personnel expenses over assets as price of labor, and other operating expenses over assets as price of fixed assets. As pointed out by Berger et al. (2009), the traditional Lerner index does not capture risk premia in the prices of banks' products and services, breaking down its positive association with the size of monopoly rents. Thus, to take into account the price of credit risk (Al-Azzam et al. 2019; Gunes et al. 2016), we also include in the vector w_j loan impairment charges (as a share of total assets).[7] The model is estimated by OLS separately for each country and the estimated (country-specific) parameters are used to calculate the elasticity as:

$$\varepsilon_{b,t} = \alpha + \delta\, logQ_{b,t} + \sum_{j=1}^{J} \beta_j w_{j,b,t} \tag{4}$$

which then allows to calculate the Lerner index as:

$$Lerner_{b,t} = 1 - \frac{mc}{p} = 1 - \varepsilon_{b,t} \frac{C_{b,t}}{Income_{b,t}} \tag{5}$$

The average Lerner index in our sample is equal to 0.236 and shows a relatively stable pattern over time. There is a certain degree of variation both between countries (ranging from a Lerner of 0.027 in Austria to one of 0.452 in Finland) and within country (in the United States, for instance, the average Lerner is 0.236 with a standard deviation of 0.112).

B. Matching

Because as noted earlier intervened banks are different than non-intervened banks pre-intervention, we follow Diamond and Sekhon (2013) and construct a control group using a multivariate matching algorithm based on the pre-intervention values of the Lerner index, bank assets, total costs, revenues, and NPLs. The algorithm implements a Mahalanobis Distance matching procedure to maximize covariate balance, meaning that the treatment and control groups have a similar joint distribution of observed covariates. We include country fixed effects in the matching algorithm. The Kolmogorov-Smirnov and the paired t-tests indicate a successful matching, given that the p-values are larger than 0.10 across all matched variables.

[7] Imposing additional structure to the cost function, for instance homogeneity of degree one in input prices, does not significantly affect the results.

After the matching, the sample of treated banks and the control group do not show any statistical difference along observables in the pre-intervention period (Table 2). Moreover, there are no differential pre-trends between the groups, as illustrated by Figures 1, 2 and 3. Our results are also robust to changes in the number of matches or to variations in the variables used for matching (see Section V). Table 3 presents summary statistics for the matched sample.

C. Empirical Specifications

To examine the impact of government interventions on the bank-level outcomes of interest—the Lerner index in particular—we adopt an event-study design:

$$y_{b,t,c} = \alpha_c + \tau_t + \sum_{j=-4}^{3} \beta_j * Intervention_b * \mathbf{1}\{t = T - j\} * + \epsilon_{b,t,c} \quad (6)$$

where $y_{b,t,c}$ is an outcome for bank *b* in year *t* in country *c*, $Intervention_b$ is a dummy variable indicating whether bank *b* received a direct government intervention, *T* is the year of such intervention (if any), and *j*, is the time with respect to the intervention. α_c , τ_t are country and time fixed effects, respectively.[8] Equation (6) is estimated with a balanced panel considering 4 periods pre- and post-intervention in the baseline and the set of β coefficients trace the difference in the evolution of the outcome variable between the intervened banks and similar (matched) banks around the time of the intervention.

For ease of exposition, we also estimate a simple difference-in-difference specification:

$$y_{b,t,c} = \alpha_c + \tau_t + \beta * Intervention_b * \mathbf{1}\{t > T\} + \epsilon_{b,t,c} \quad (7)$$

in which the coefficient β summarizes the differential evolution of the outcome variable between intervened and non-intervened banks after the government intervention. In both approaches, we cluster the standard errors at the bank level, to allow for within-cluster correlation between government intervention and the error term.

The empirical analysis is designed to correctly assess the impact of interventions under the assumption that—after the matching procedure—there is no unobservable characteristic impacting the change in market power after the intervention for treated banks with respect to the untreated ones. This assumption could be violated if, for instance, governments knew which banks were going to increase or decrease their market power and decided to target banks along this dimension (e.g., to avoid losses of consumers' welfare or, conversely, to support bank profitability). However, the fact that there are no different pre-trends between control and treated groups (see Section IV) mitigates such a concern.

[8] We also conduct regressions with bank fixed effects as detailed below in Section IV.B.

IV. RESULTS

A. Main Results

The main result of the paper is illustrated by Figure 1, which plots the difference in the Lerner index between intervened banks and the matched (non-intervened) ones over an 8-year window around the intervention. The estimates indicate a 0.02 reduction in the Lerner index in the year of the government intervention. This drop is statistically significant and persists in the three years post intervention. The drop is sizeable in magnitude as it is equal to about 20 percent of the median Lerner index in the matched sample. By contrast, there is no difference in the Lerner between the treated and matched control groups in the pre-intervention period (i.e., the difference is precisely estimated and close to zero).

The reduction in the Lerner index is entirely driven by an increase in the marginal cost of assets, which is not matched by an equivalent increase in prices. In fact, prices are not affected at all by government interventions (see Table 4, columns 2 and 3), which indicates that the cost increase is fully absorbed by the bank and not passed on to the borrowers or other clients. This suggests that intervened banks experience a decrease in their ability to price over marginal costs.

To dig deeper into the mechanisms behind the change in market power, we further decompose total costs into the main components: interest expenses and total operating costs. The latter is further decomposed into wages, other operating expenses and loan impairment charges.[9] Results are shown in Table 5. We find that the rise in costs is not driven by a higher cost of funding (column 2) nor by higher wages (column 3), but mostly by loan impairment charges (column 5), which drive the evolution of total operating expenses (column 6). The dynamic response of these two variables post-intervention is similar, with a sharp increase in the year of intervention, a further acceleration the year after and then a gradual decline (although operating expenses and loan impairment charges are still significantly higher than pre-intervention even after three years, see Figure 2). Similarly, we split the effect of prices between interest and non-interest revenues and we find that the lack of a significant effect on prices is confirmed in the two components (Table 6).

Given the key role of loan impairment charges in driving the variation in market power after government intervention, we test whether this is associated with an expansion of the loan portfolio of intervened banks (Table 7). We find that this is not the case, looking either at net loans or loans over assets. By contrast, higher impairment charges seem to go hand in hand with an increase in NPLs. Since, as mentioned earlier, we observe no increase in prices, we rule out the possibility that the change in loan impairment charges resulted from an increase or shift towards riskier loans.

[9] More precisely, total operating expenses is the sum of personnel and other operating expenses (which correspond to non-interest expenses), plus loan impairment charges and equity-accounted profit/loss.

These findings give support to one possible mechanism through which government intervention in a bank may reduce the bank's market power: recognition of losses. Suppose banks price their loans considering their cost of funding, cost of capital, and expected losses. When there is a government intervention, two things happen: first, the new stakeholder has an incentive (if not mandate) to put the bank back in shape, ideally on a sustainable basis; second, there are now buffers to absorb the losses. Hence, the bank re-evaluates its loans on a lifetime expected loss basis and should adjust loan pricing accordingly.[10] Our evidence, however, shows that the bank does the former but not the latter—suggesting a lack of market power (Figure 3).

B. Robustness

We substantiate our results running a set of checks aimed at testing their robustness to changes in: the timing, the methodology, and the sample in our analysis.

We start by varying the event window and consider between 1 and 5 years around the intervention, we then use between 1 and 4 matches for each intervened bank to construct the control group, and we finally substitute country fixed effects with bank fixed effects, to better control for unobserved bank-specific characteristics which may explain differences in the dynamics of the Lerner index. Results are shown in Appendix Tables 1 to 3 and confirm our baseline estimates, as the point estimates remain very close to what we obtain before and significant at 1 percent.

One element of novelty of our analysis is the cross-country dimension. However, as our sample of banks is skewed towards US institutions, we replicate our main results splitting the sample between US and non-US banks. Results are qualitatively similar, although the drop in the Lerner index is larger among US banks (Table 8). A similar conclusion can be drawn if instead of splitting the sample we weigh the observations in order to give equal weights to each country in the overall sample (see Appendix Table 4).

Using yearly data may exacerbate the endogeneity of the treatment, as government interventions could happen later in the year in response to the increase in costs (and loan impairment charges) which is driving the Lerner index. To address this concern, we augment our model with a triple interaction with the month of the intervention in a given year. If our results were due mostly to interventions undertaken late in the year in response to a decline in the Lerner index, we should observe a significant and negative coefficient for the triple interaction term. However, this is not

[10] Such an impact on loan pricing is consistent with industry surveys in which banks report their expectation that implementation of a new accounting regime (IFRS 9) that would require prompt recognition of loan impairment will have an impact on lending practices in terms of the pricing of products (Gross et al. 2020).

the case and the point estimate is very close to zero, suggesting that we can dismiss this concern (Appendix Table 5).[11]

C. Heterogeneity

In this section we present a set of additional results which examine whether there is evidence of heterogeneity in the results based on the type, size and duration of the interventions, bank characteristics, and macroeconomic conditions.

We start by exploiting the granular information on government interventions, which allow us to test for variations in the size (measured by the injection over assets), duration (measured by the number of years until the end of public support measures) and type (equity version non-equity injections).

When looking at different types of interventions, we focus on asset purchases, since they capture the stake a government takes in a bank more directly.[12] Splitting the sample between equity and non-equity interventions, we find that market power declines significantly only for banks that experienced equity injections and not for other interventions (debt or hybrid, Table 9). While this result should be interpreted with caution, given the limited sample size for non-equity interventions, it is consistent with equity injections giving greater, power, incentives, and responsibilities to governments to either directly impact banks' operations or, at least, monitor them more closely and require banks to recognize losses appropriately. We also find larger effects on market power and on the cost components for interventions involving larger amounts of government support and lasting over longer periods (duration from initial injection to divestment) (Table 10). This is again consistent with the idea that a more sizeable involvement of public authorities leads to an increase in costs due to a more appropriate recognition of risks; larger injections of taxpayer money may also align banks' objectives closer to those of their clients, diminishing any incentive to pass the cost increases to them.

[11] As the main variable of interest, the Lerner index, is estimated in a first stage (which also uses some of the covariates entering the main equation), the estimates of equation (7) may suffer from a form of "generated regressor" problem (Pagan 1984), and the relative standard error estimates may be invalid. As it is common in the literature (e.g. Ashraf and Galor 2013), we perform a bootstrapping procedure by re-estimating both the first stage (Lerner Index) and second stage (equation (7)) with 500 bootstrapped samples. Reassuringly, our results remain significant at 1 percent (standard error = 0.005) when relying on the standard errors obtained with this bootstrapping procedure (results unreported for the sake of brevity).

[12] Guarantees, by contrast, are extended but not always incurred, while impaired asset relief is counted only when the transfer value exceeds the market value.

We also explore heterogeneity in the effects of government interventions on banks depending on bank and country characteristics. We consider bank's market share, size, profitability, leverage and asset quality and find that our results do not vary based on pre-intervention bank characteristics (Appendix Table 6). The lack of differences depending on leverage is also confirmed when looking at the country level (Table 11, column 1). However, we do find that the decline in the Lerner is larger for banks headquartered in countries that suffered a deeper economic contraction during the GFC. To quantify this result, the decline in Lerner is 0.0085 greater for an intervened bank in a country where GDP per capita fell by an additional 1 percent (Table 11, column 2). This is a substantial difference as it represents more than a third of the baseline effect. A likely explanation of this heterogeneity is that countries where the crisis was more severe also experienced a larger increase in credit risk, which, once banks are forced to recognize loans in a prompter way, led to a larger increase of the marginal costs of lending.

V. CONCLUSIONS

The COVID-19 pandemic could lead to significant bank losses, due to household and firm insolvencies. Governments might have to resort to various forms of interventions to support banks and to avoid that a financial crisis further exacerbates the severe economic downturn brought about by the pandemic.

Conceptually, the impact of interventions on banks' market power is a priori ambiguous. This paper studies GFC-era government interventions in the banking industry to gain insights on what might be the impact on banks' market power going forward. In particular, we contribute to the existing literature by analyzing government interventions using bank level data for 800 banks in 27 countries between 2007 and 2017.

Our analysis shows that banks that received direct equity injections (but not other types of interventions) experienced a significant decline in their pricing over marginal costs. Specifically, intervened banks exhibited a significant increase in costs, due to greater recognition of loan losses, which was not matched by higher prices. This effect was more pronounced for larger and longer interventions and in countries that experienced sharper output losses. The results are invariant to various robustness checks.

Overall, our findings mitigate the concern that future interventions may lead to substantial welfare losses due to an increase in lenders' market power, as could occur if intervened banks were perceived to be safer and were able to charge higher prices or pay lower funding costs as a result. At the same time, the fact that intervened banks do not seem to match the increase in marginal costs with an increase in prices may raise concerns about the long-run viability of these banks with potential implications for financial stability. We leave this question for future research.

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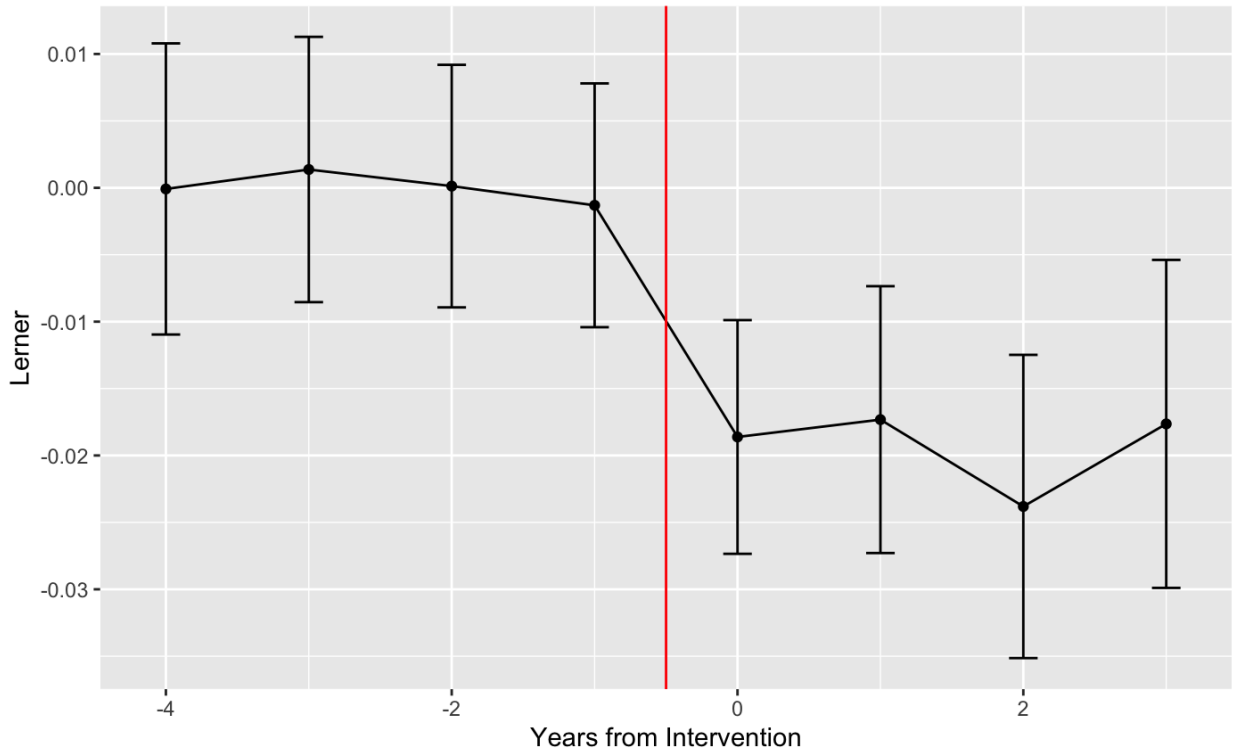
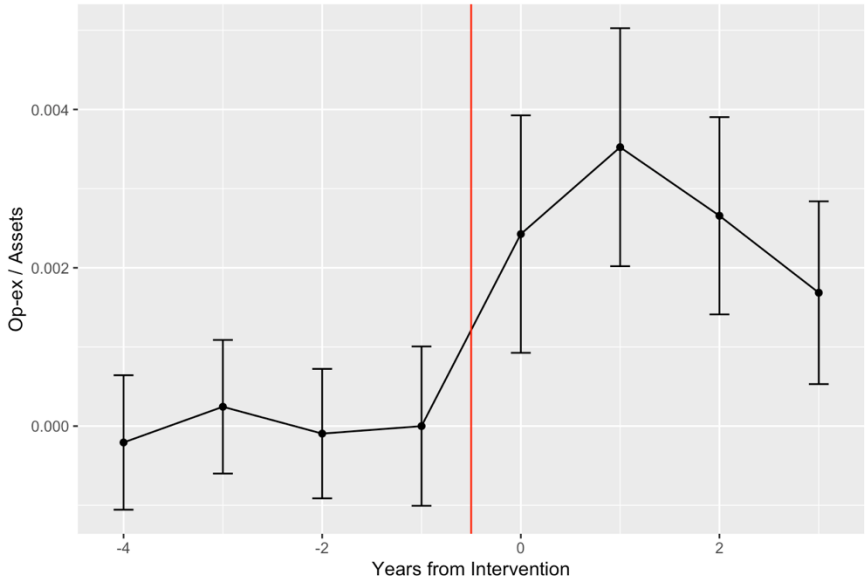
Figures and Tables

Figure 1: Impact of banking intervention on Lerner index

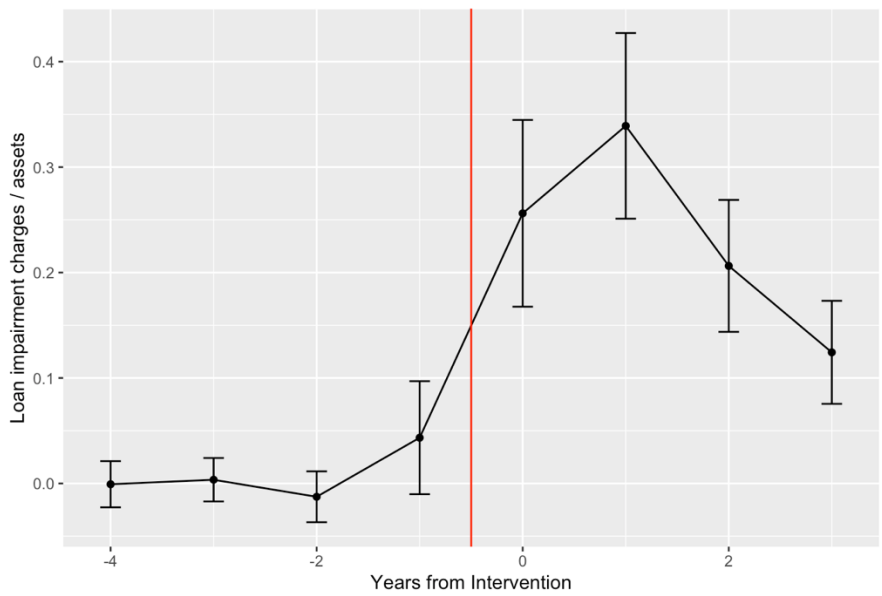


Notes: This figure plots the coefficients β_r and standard errors from the event study specification in Section III (equation 6) with the Lerner index as $y_{b,t,c}$. Country fixed effects are included.

Figure 2: Impact of banking intervention on costs



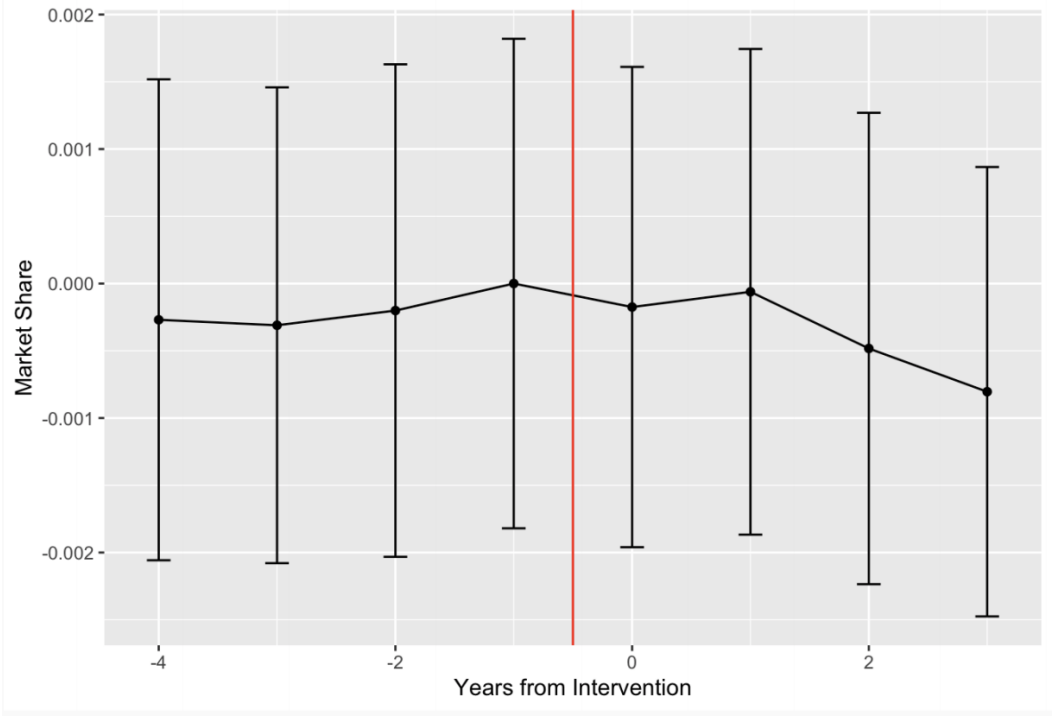
(a) Total Operating Expenses



(b) Loan Impairment Charges

Notes: This figure plots the coefficients β_r and standard errors from the event study specification in Section III (equation 6) with total operating expenses over assets as $y_{b,t,c}$ in Figure (a) and loan impairment charges over assets as $y_{b,t,c}$ in Figure (b). Total operating expenses is the sum of personnel and other operating expenses (which correspond to non-interest expenses), plus loan impairment charges and equity-accounted profit/loss. Country fixed effects are included.

Figure 3: Impact of banking intervention on market share



Notes: This figure plots the coefficients β_τ and standard errors from the event study specification in Section III (equation 6) with country market share as $y_{b,t,c}$. Country fixed effects are included.

Table 1: Differences in pre-intervention characteristics across banks in full sample

Dependent Variable:	Assets	ROA	NPL/Loans	Lerner
	(1)	(2)	(3)	(4)
Intervention	1.599***	-0.156***	-0.214**	-0.034***
	(0.077)	(0.042)	(0.086)	(0.004)
Country FE	Yes	Yes	Yes	Yes
Observations	16964	16964	16964	16636
Adjusted R^2	0.513	0.092	0.516	0.056

Notes: This table presents OLS estimates at the bank level on the full sample. Intervention indicates that the bank is a recipient of a government intervention. Pre-intervention characteristics are defined as the mean over years 2004-2006. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: Differences in pre-intervention characteristics across banks in matched sample

Dependent Variable:	Assets	ROA	NPL/Loans	Lerner
	(1)	(2)	(3)	(4)
Intervention	0.462	0.025	-0.095	-0.002
	(0.316)	(0.052)	(0.111)	(0.004)
Country FE	Yes	Yes	Yes	Yes
Observations	2253	2253	2253	2253
Adjusted R^2	0.770	0.035	0.185	0.078

Notes: This table presents OLS estimates at the bank level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Pre-intervention characteristics are defined as the mean over the 4 pre-intervention periods. Country fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Summary statistics for matched sample

	N	# of Banks	25th	Median	75th
Lerner	18024	2253	0.0094	0.1089	0.1900
Net Loans	18024	2253	125.0	498.0	1992.7
Total Assets	18024	2253	178.9	721.5	2899.8
Deposits	18024	2253	144.3	556.2	2026.2
Net Interest Margin	18024	2253	3.10	3.65	4.20
Loan Impairment Charges / Assets	18024	2253	0.1212	0.2989	0.7103
ROE	18024	2253	1.680	6.460	10.981
ROA	18024	2253	0.1257	0.5558	0.9521
Revenue / Assets	18024	2253	0.0508	0.0590	0.0678
Marginal Cost	18024	2253	0.0448	0.0541	0.0638

Notes: This table presents summary statistics for variables measured at the bank-year level on the matched sample.

Table 4: Difference-in-differences effect of banking interventions on Lerner index

Dependent Variable:	Lerner	Price	MC
	(1)	(2)	(3)
Intervention x Post	-0.020***	0.000	0.004***
	(0.003)	(0.001)	(0.001)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Window	4	4	4
# of Matches	2	2	2
# of Treatment Obs.	730	730	730
Adjusted R2	0.215	0.559	0.420

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner, Price and Marginal Cost (MC) are constructed as in Section IIIa. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Difference-in-differences effect of banking interventions on components of cost

Dependent Variable:	MC	Interest	Personnel	Other Operating	Loan Impairment	Total Operating
	(1)	(2)	(3)	(4)	(5)	(6)
Intervention x Post	0.002***	0.000	-0.013	0.0005*	0.214***	0.003***
	(0.001)	(0.001)	(0.013)	(0.0003)	(0.028)	(0.001)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Window	4	4	4	4	4	4
# of Matches	2	2	2	2	2	2
# of Treatment Obs.	730	730	730	730	730	730
Adjusted R2	0.420	0.658	0.420	0.471	0.235	0.412

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Marginal Cost (MC) is constructed as in Section IIIa. All components of cost in Columns 3 – 6 are divided by total assets. Total operating expenses is the sum of personnel and other operating expenses (which correspond to non-interest expenses), plus loan impairment charges and equity-accounted profit/loss. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Difference-in-differences effect of banking interventions on components of price

Dependent Variable:	Price	Interest	Non-Interest
	(1)	(2)	(3)
Intervention x Post	0.000	0.001	0.000
	(0.001)	(0.003)	(0.002)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Window	4	4	4
# of Matches	2	2	2
# of Treatment Obs.	730	730	730
Adjusted R2	0.559	0.512	0.498

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Price is constructed as in Section IIIa. Interest is defined as total interest revenue over loans, and non-interest is defined as total non-interest revenue over assets. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Difference-in-differences effect of banking interventions on lending

Dependent Variable:	NPL / Loans	Net Loans	Loans / Assets
	(1)	(2)	(3)
Intervention x Post	0.441***	0.080	0.005
	(0.112)	(0.066)	(0.007)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Window	4	4	4
# of Matches	2	2	2
# of Treatment Obs.	730	730	730
Adjusted R2	0.339	0.540	0.128

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Net loans is measured in logarithms, while Loans/Assets is the ratio between gross loans and total assets. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Difference in difference effect of banking interventions – United States vs non-United States

Dependent Variable:	Lerner	MC	Price	Loan Impairment
	(1)	(2)	(3)	(4)
Panel A: United States				
Intervention x Post	-0.018***	0.003***	0.000	0.228***
	(0.005)	(0.001)	(0.001)	(0.030)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Window	4	4	4	4
# of Matches	2	2	2	2
# of Treatment Obs.	642	642	642	642
Adjusted R2	0.200	0.157	0.188	0.241
Panel B: Non- United States				
Intervention x Post	-0.012*	0.005***	-0.001	0.226***
	(0.007)	(0.0020)	(0.0020)	(0.0075)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Window	4	4	4	4
# of Matches	2	2	2	2
# of Treatment Obs.	132	132	132	132
Adjusted R2	0.520	0.857	0.188	0.499

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III, restricted to United States banks in Panel A and restricted to non-United States banks in Panel B. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner, Price and Marginal Cost (MC) are constructed as in Section IIIa. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Heterogeneity by intervention type

Dependent Variable:	Lerner (1)	MC (2)	Price (3)	Lerner (4)	MC (5)	Price (6)
Intervention x Post	-0.019***	0.003***	0.004	-0.010	-0.001	-0.003
	(0.004)	(0.001)	(0.001)	(0.013)	(0.004)	(0.003)
Intervention Type	Equity	Equity	Equity	Non-Equity	Non-Equity	Non-Equity
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Window	4	4	4	4	4	4
# of Matches	2	2	2	2	2	2
# of Treatment Obs.	650	650	650	50	50	50
Adjusted R2	0.220	0.242	0.309	0.288	0.836	0.872

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III, restricted to equity interventions in Columns 1-3 and restricted to non-equity interventions in Columns 4-6. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner is constructed as in Section IIIa. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Heterogeneity by intervention characteristics

Dependent Variable:	Lerner (1)	Lerner (2)	Lerner (3)	Loan Imp. (4)	Loan Imp. (5)	Loan Imp. (6)
Intervention x Post x Size	-0.663***			2.518***		
	(0.112)			(0.905)		
Intervention x Post x Duration		-0.005***			0.051***	
		(0.001)			(0.010)	
Intervention x Post x M&A			-0.001			-0.073
			(0.008)			(0.062)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Window	4	4	4	4	4	4
# of Matches	2	2	2	2	2	2
# of Treatment Obs.	730	730	730	730	730	730
Adjusted R2	0.223	0.234	0.218	0.259	0.246	0.236

Notes: This table presents OLS estimates of a regression at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Size is measured as the total amount of the injection. Duration is the number of years from the initial injection to divestment. M&A is an indicator for whether there was an M&A in the same year of the intervention. Lerner is constructed as in Section IIIa. Country and time fixed effects are included. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

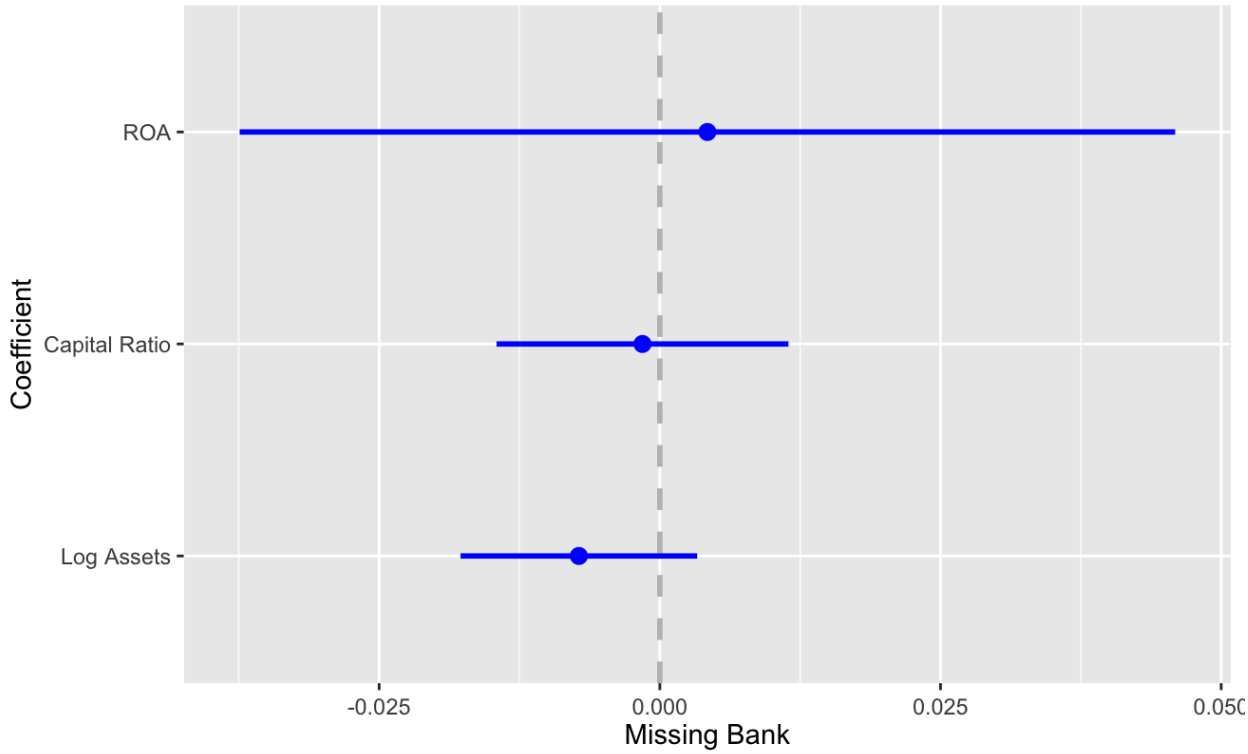
Table 11: Heterogeneity by country characteristics

Dependent Variable:	Lerner	Lerner
	(1)	(2)
Intervention x Post x % change in GDP per capita during GFC	0.850**	
	(0.300)	
Intervention x Post x pre-GFC Leverage Ratio		-0.038
		(0.129)
Country FE	Yes	Yes
Time FE	Yes	Yes
Window	4	4
# of Matches	2	2
# of Treatment Obs.	730	730
Adjusted R2	0.212	0.213

Notes: This table presents OLS estimates of a regression at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. % change in GDP per capita during GFC is measured as the change between 2008 and 2009. Pre-GFC Leverage Ratio is the average leverage ratio in the 4 pre-intervention periods. Lerner is constructed as in Section IIIa. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

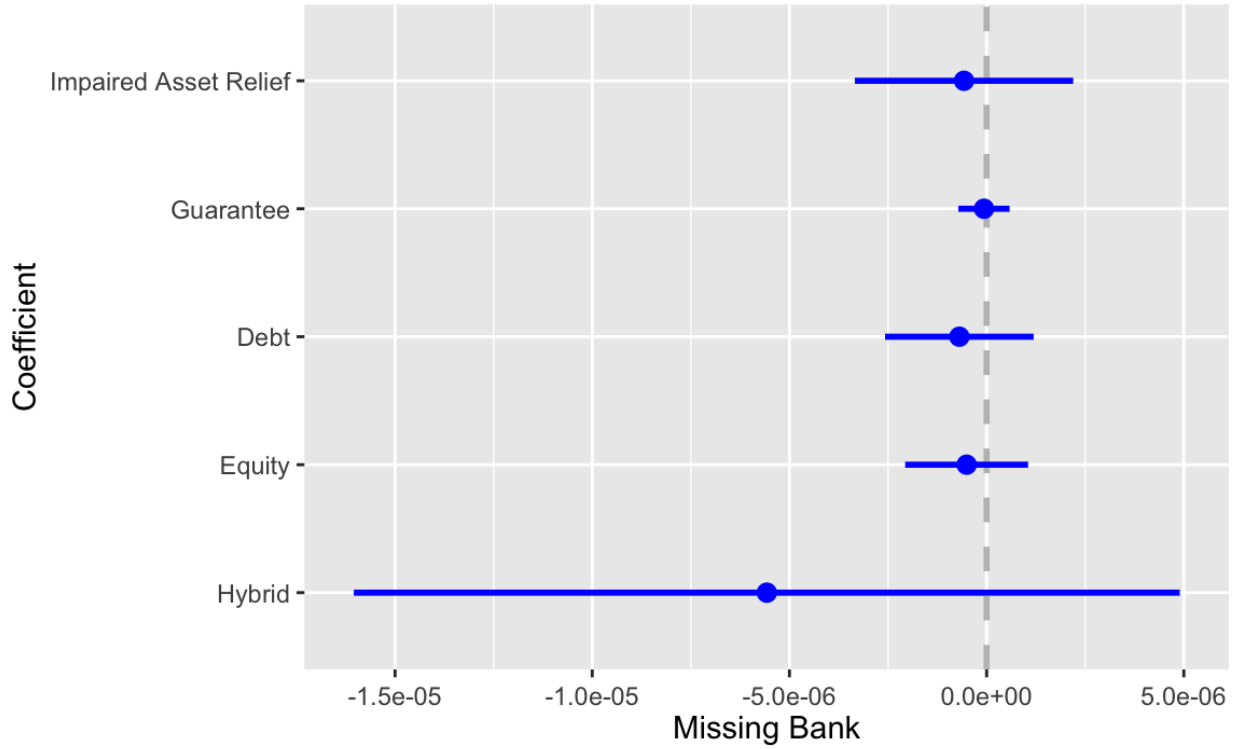
Appendix Figures and Tables

Appendix Figure 1: Differences in covariates between missing and matched banks



Notes: This figure plots the coefficients from a regression of an indicator for being an unmatched (or missing) bank in FitchConnect on ROA, capital ratio, and log assets as constructed in Igan et al. (2019). The sample is all intervened banks from Igan et al. (2019).

Appendix Figure 2: Differences in intervention size between missing and matched banks



Notes: This figure plots the coefficients from a regression of an indicator for being an unmatched (or missing) bank in FitchConnect on the size of the intervention by intervention type. The sample is all intervened banks from Igan et al. (2019)

Appendix Table 1: Interventions by instrument in Igan et al. (2019)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Equity											
Number of banks	0	231	500	20	21	23	17	6	9	2	8
o/w US banks	0	211	446	0	0	0	0	0	0	0	0
Percent of system assets	0.0	17.2	13.7	1.2	0.8	1.3	0.5	0.1	0.2	0.0	0.2
o/w US banks	0.0	7.7	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hybrid securities											
Number of banks	0	8	63	5	4	8	2	0	2	0	1
o/w US banks	0	3	51	0	0	0	0	0	0	0	0
Percent of system assets	0.0	2.1	0.8	0.4	0.1	0.5	0.0	0.0	0.2	0.0	0.1
o/w US banks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Debt											
Number of banks	2	11	12	4	5	3	2	1	1	0	0
o/w US banks	0	0	0	0	0	0	0	0	0	0	0
Percent of system assets	0.1	0.3	0.1	0.0	0.2	0.3	0.5	0.0	0.0	0.0	0.0
o/w US banks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Sources: National authorities; European Commission; bank reports.

Note: This table shows the banks that were subject to asset purchases by year in absolute numbers (*"number of banks"*) and in terms of their assets as a percent of total system assets (*"percent of system assets"*) by type of instrument (equity, hybrid instruments, and debt). System assets are the total assets of the financial sector in the sample. Data reflect the available information as of April 2018 for EU countries and as of end-2018 for the United States.

Appendix Table 2: Robustness for event window

Dependent Variable:	Lerner (1)	Lerner (2)	Lerner (3)	Lerner (4)	Lerner (5)
Intervention x Post	0.017***	0.020***	-0.018***	0.016***	0.014***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Window	5	4	3	2	1
# of Matches	2	2	2	2	2
Adjusted R2	0.220	0.215	0.221	0.203	0.190

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. Window indicates the length of the window, number of periods pre and post intervention. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner is constructed as in Section IIIa. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 2: Robustness for number of matches

Dependent Variable:	Lerner (1)	Lerner (2)	Lerner (3)	Lerner (4)
Intervention x Post	0.019***	0.020***	0.020***	0.019***
	(0.002)	(0.003)	(0.003)	(0.003)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Window	4	4	4	4
# of Matches	2	3	2	1
Adjusted R2	0.210	0.207	0.215	0.220

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. # of Matches indicates the number of matches for each treatment observation following Diamond and Sekhon (2013). Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner is constructed as in Section IIIa. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 3: Robustness to bank fixed effects

Dependent Variable:	Lerner (1)	Lerner (2)
Intervention x Post	0.020***	0.018***
	(0.003)	(0.002)
Country FE	Yes	No
Bank FE	No	Yes
Time FE	Yes	Yes
Window	4	4
# of Matches	2	2
Adjusted R2	0.215	0.620

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner is constructed as in Section IIIa. Time fixed effects are included. Country fixed effects are included in Column 1 and bank fixed effects are included in Column 2. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 4: Robustness to weighting each country equally

Dependent Variable:	Lerner (1)	MC (2)	Price (3)	Loan Impairment (4)
Intervention x Post	-0.020***	0.003***	-0.0002	0.243***
	(0.001)	(0.0002)	(0.0002)	(0.009)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Window	4	4	4	4
# of Matches	2	2	2	2
# of Treatment Obs.	730	730	730	730
Adjusted R2	0.209	0.431	0.573	0.233

Notes: This table presents OLS estimates of equation (7) at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner, Price and Marginal Cost (MC) is constructed as in Section IIIa. Country and time fixed effects are included. Each observation is weighted by the inverse of the number of country banks in the matched sample. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 5: Robustness to timing of intervention within year

Dependent Variable:	Lerner (1)	Lerner (2)
Intervention x Post x Month	-0.001	
	(0.004)	
Intervention x Post x 1{Month <= 6}		0.003
		(0.005)
Country FE	Yes	Yes
Time FE	Yes	Yes
Window	4	4
# of Matches	2	2
# of Treatment Obs.	730	730
Adjusted R2	0.214	0.213

Notes: This table presents OLS estimates at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. Lerner is constructed as in Section IIIa. Month is corresponds the month number of the intervention from 1 to 12 (January is 1). 1{Month <= 6} is an indicator for the first half of the year. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 6: Heterogeneity by bank characteristics

Dependent Variable:	Lerner (1)	Lerner (2)	Lerner (3)	Lerner (4)	Lerner (5)
Intervention x Post x Market Share	0.096				
	(0.159)				
Intervention x Post x Assets		0.000			
		(0.001)			
Intervention x Post x ROA			-0.001		
			(0.003)		
Intervention x Post x Leverage Ratio				0.0004	
				(0.001)	
Intervention x Post x NPLs/Loans					-0.0003
					(0.000)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Window	4	4	4	4	4
# of Matches	2	2	2	2	2
# of Treatment Obs.	730	730	730	730	730
Adjusted R2	0.212	0.214	0.309	0.220	0.224

Notes: This table presents OLS estimates of a regression at the bank-year level on the matched sample as explained in Section III. Intervention indicates that the bank is a recipient of a government intervention. Post indicates the year is after the bank intervention. % change in GDP per capita during GFC is measured as the change between 2008 and 2009. Lerner is constructed as in Section IIIa. All interaction variables are from FitchConnect. Country and time fixed effects are included. Standard errors, clustered by bank, in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.